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Forest Pest Management Report

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ANNUAL SOUTHWESTERN REGION
PEST CONDITIONS REPORT
1987

March 1988

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CONTENTS

FOREWARD 1

CONDITIONS IN BRIEF. 2

STATUS OF MAJOR INSECT PESTS 2

Mountain pine beetle. 2
Western pine beetle 2
Ips engraver beetles. 2
Spruce beetle 3
Pandora moth. 3
Western spruce budworm. 3

STATUS OF PEST COMPLEXES 4

Aspen defoliators 4
Douglas-fir mortality 4
True fir mortality. 4

STATUS OF OTHER INSECTS. 5

STATUS OF DISEASES 7

Dwarf mistletoes. 7
Stem cankers and decay. 7
Root diseases 7
Foliage diseases. 7
Nursery diseases. 8

FOREST PEST MANAGEMENT ACTIVITIES IN 1987

Detection surveys 12
Evaluations 12
Entomology 12
Pathology. 13
Suppression projects. 13
Integrated Forest Protection and
Integrated Resource Management Concepts. 14

RECENT PUBLICATIONS. 15

FOREWARD

This publication reports the status of major insects and diseases on Southwestern forests in 1987. Much of the information presented in this publication is based on aerial and ground surveys conducted by Forest Pest Management (FPM) Specialists, Southwestern Region, and State Pest Management Specialists of the Division of Forestry, Arizona State Land Department, and the New Mexico Department of Agriculture. These surveys report short-term changes in pest activity as well as indicating long-term trends when compared to previous surveys. Both types of information may be of interest and importance to National Forest, other Federal, State, and private forest land managers.

As in the past, FPM has compiled the information for lands of all ownerships; if required, further information and additional copies of this publication are available upon request.

CONDITIONS IN BRIEF

In the Southwest, bark beetle-caused tree mortality increased slightly from 10,400 acres in 1986 to 12,059 acres in 1987, and resulted in approximately 516,350 cubic feet of volume loss. The mountain pine beetle caused the greatest mortality in the ponderosa pine forest cover type (106,850 cubic feet), followed by the western pine beetle (44,250 cubic feet), and Ips beetles (39,450 cubic feet). In the spruce and mixed conifer forest cover types, the spruce beetle and Douglas-fir and true fir pest complexes caused an estimated 100,000, 154,000, and 71,800 cubic feet of volume loss, respectively.

Acreage defoliated Regionwide decreased from 509,606 acres in 1986 to 289,220 acres in 1987. Most of the defoliation damages observed were caused by the western spruce budworm (265,940 acres) and large aspen tortrix (21,440 acres). The pandora moth and white fir needle miner also caused some minor defoliation in the ponderosa pine (720 acres) and white fir (1,120 acres) cover types, respectively.

Dwarf mistletoe caused an estimated annual loss of 25 million cubic feet of volume Regionwide. Dwarf mistletoe surveys were conducted on 78,857 acres and control projects were completed on a total of 493 acres of infected ponderosa pine.

Root and butt rots are another important cause of wood volume loss in the Southwestern Region. Annual losses are estimated at 1.9 million cubic feet.

STATUS OF MAJOR INSECT PESTS

Mountain pine beetle, Dendroctonus ponderosae. Acreage of mountain pine beetle-killed trees in the Southwest decreased from 2,050 acres in 1986 to approximately 1,190 acres in 1987. Tree mortality resulting from these bark beetle infestations was estimated at 106,850 cubic feet Regionwide. The majority of these losses occurred in northern New Mexico on the Carson National Forest, the Taos Pueblo Indian Reservation, and the privately owned Moreno Ranch. Tree mortality on these Federal and private ownerships ranged from widely scattered individual trees to concentrated groups of 20 to 200 fading trees.

Western pine beetle, Dendroctonus brevicomis. Western pine beetle-caused tree mortality was also minor throughout the Region in 1987. Individual and small group (less than five trees) tree mortality, detected on an estimated 325 acres and totaling 44,250 cubic feet of volume, occurred on the Coconino, Coronado, Kaibab, and Tonto National Forests, and the Navajo Indian Reservation in Arizona, and the Gila National Forest in New Mexico.

Ips engraver beetles, Ips spp. Ips engraver beetle activity in 1987 caused minor levels of tree mortality throughout the Region in 1987. Ips-caused tree mortality was detected on approximately 3,020 acres Regionwide, and resulted in an estimated 39,450 cubic feet of volume loss. The largest incidence of tree mortality was detectd on the San Carlos Apache Indian Reservation, AZ, where concentrated groups of 30 to more fading trees were observed. Elsewhere throughout the Region, on the Coconino, Coronado, Kaibab, and Tonto National Forests, and the Navajo Indian Reservation in Arizona, and the Cibola and

Lincoln National Forests and the Mescalero Apache Indian Reservation in New Mexico, Ips-related tree mortality was minor, consisting of mostly widely scattered individual trees and some occasional small group (less than five trees) tree mortality. On state and private lands in the Region, minor Ips beetle activity was detected near Santa Fe in New Mexico and in the Prescott and Show Low-Pinetop areas in Arizona.

Spruce beetle, Dendroctonus rufipennis. In 1987, spruce beetle activity was aerially detected on approximately 1,238 acres of the spruce forest cover type throughout the Region. Most of the mortality detected occurred in northern New Mexico on the Carson (Pecos Wilderness) and Santa Fe National Forests, and the privately-owned Vermejo Ranch. Losses resulting from these bark beetles were collectively estimated at over 100,000 cubic feet of volume.

Western spruce budworm, Choristoneura occidentalis. Western spruce budworm defoliation of Douglas-fir, true firs, and spruce decreased from 469,416 acres in 1986 to 265,940 acres in 1987 (Table 1). The most extensive areas of defoliation continued to occur on the Carson (168,760 acres) and Santa Fe (52,680 acres) National Forests and adjacent and nearby private ownerships (21,100 acres) in New Mexico, and the Kaibab National Forest (15,520 acres) in Arizona. Smaller areas of budworm defoliation were also detected on the Cibola (2,840 acres) and Lincoln (1,680 acres National Forests and the Jemez Pueblo (1,680 acres) and Jicarilla Apache (1,880 acres) Indian Reservations in New Mexico. Defoliation detected on adjacent and nearby private forested lands in northern New Mexico occurred on the Tierra Amarilla Grant (17,132 acres), Baca Location No. 1 (1,400 acres), Moreno Ranch (740 acres), and Vermejo Ranch (1,809 acres). Conservative estimates place current year's radial growth reduction due to budworm defoliation at 1.9 million cubic feet Regionwide.

Pandora moth, Coloradia pandora. Pandora moth defoliation was detected on approximately 720 acres of the ponderosa pine forest type on the north rim of the Grand Canyon National Park near Cape Royale, AZ. Pandora moth defoliation was first detected near Cape Royale in 1985 when nearly 760 acres of host type were defoliated. Because this insect has a two year life cycle, defoliation damages, classified as light in 1987, are not expected to occur again until 1989.

Table 1--Acres of western spruce budworm defoliation, Southwestern Region, 1987.

Land Ownership Class	Relative Defoliation (acres)			
	Light	Moderate	Heavy	Total
National Forest	98,560	131,440	11,280	241,280
Indian Lands	1,680	1,880	0	3,560
Private Ownerships	14,850	6,231	0	21,081
Total	115,090	139,551	11,280	265,921

STATUS OF PEST COMPLEXES

Tree mortality and radial growth loss often result from a combination of insects and disease-related complexes (including abiotic factors) throughout the various forest cover types in the Southwest. Mortality resulting from these pest complexes generally occurs as widely scattered individual and small group (less than five trees) tree mortality. Although ascribed to bark beetle attacks, the majority of these trees killed are initially weakened by such factors as drought, overstocking, defoliation, fire, root diseases, dwarf mistletoes, and/or poor site conditions. Some pest complex-related losses in the Southwest include those associated with aspen defoliation, and Douglas-fir and true fir mortality.

Aspen defoliators. Large aspen tortrix, Choristoneura conflictana; western tent caterpillar, Malacosoma californicum; ink spot disease, Ciborinia whetzelii; and Marssonina leaf spot disease, Marssonina populi. Collectively, this complex of insects and diseases defoliated over 24,280 acres of the aspen forest cover type Regionwide. On Federal lands defoliation of aspen stands, estimated at 21,440 acres, was most conspicuous on the Carson, Cibola, and Santa Fe National Forests in New Mexico and the Navajo Indian Reservation in Arizona. An additional 2,840 acres of aspen defoliation was also detected on interspersed private ownerships such as the Baca Location No. 1, the Tierra Amarilla Grant, and the Moreno Valley in northern New Mexico.

Douglas-fir mortality. Acreage of Douglas-fir mortality aerially detected in the Region increased more than two fold, from 1,940 acres in 1986 to 5,020 acres in 1987. Although some minor Douglas-fir tree mortality was detected on the Coconino and Kaibab National Forests and Grand Canyon National Park, AZ, most of the mortality in the Region continued to occur in northern New Mexico on the Carson and Santa Fe National Forests, the Taos Pueblo Indian Reservation, and nearby adjacent private lands. While the Douglas-fir beetle, Dendroctonus pseudotsugae, was identified as the primary cause of most of the mortality observed, almost all of the trees killed in 1987 were predisposed to bark beetle attack by: (1) Several years of severe western spruce budworm defoliation, (2) dwarf mistletoe, Arceuthobium douglasii, infections, (3) various root diseases, and (4) poor site conditions. Current year's volume losses resulting from this pest complex were estimated at more than 154,000 cubic feet Regionwide.

True fir mortality. True fir mortality caused by the fir engraver, Scolytus ventralis, the primary bark beetle found attacking white fir; the western balsam bark beetle, Dryocetes confusus, which commonly attacks subalpine or cork bark fir; and associated host tree related root diseases resulted in an estimated 71,800 cubic feet of volume loss on 1,266 acres of host type throughout the Southwest. Mortality resulting from this pest complex in 1987, which consisted of widely scattered individual and small group (less than five trees) tree mortality, was detected on the Coconino, Coronado, and Kaibab National Forests, and the Navajo Indian Reservation in Arizona, and the Carson, Gila, and Santa Fe National Forests in New Mexico.

Table 2--Status of other insects in Arizona and New Mexico, 1987

Insect	Host	Location	Remarks
Conifer aphids *Cinara* spp.	Pinyon, ponderosa pine	Arizona	Caused some minor concern among private land owners in Payson and Prescott.
Douglas-fir tussock moth *Orgyia pseudotsugata*	Douglas-fir, true firs, spruce	New Mexico	Caused minor defoliation to ornamental true firs and spruce in San Antonio and Los Alamos. Infested trees were treated with ground spray applications of carbaryl.
European elm scale *Gossyparia spuria*	American elm	New Mexico	Caused minor limb and branch dieback in many urban situations in northern New Mexico.
Gypsy moth *Lymantria dispar*	Hardwoods, conifers	New Mexico	Pheromone trap surveys revealed no trap catches in 1987. These surveys will be conducted statewide again in 1988.
Pine budworm, pine needlesheath miner complex *Choristoneura lambertiana* *Zelleria hambachi*	Ponderosa pine	Arizona	Caused minor damage to new tree growth on private ownerships in the Flagstaff area.
Pine tip moth *Rhyacionia* spp.	Ponderosa pine	Arizona, New Mexico	Caused noticeable damage on ornamental ponderosa pine seedlings and saplings in Flagstaff, AZ, and Albuquerque, NM. An infestation of tip moth was also reported on an *Eldarica* pine plantation in Phoenix, AZ.
Pinyon needle miner *Coleotechnites edulicola*	Ponderosa pine	New Mexico	Defoliation was detected on a total of 6,000 acres of state and private lands in northern New Mexico near Tres Piedras and Santa Fe. In areas defoliated for nine or more years, some limb, branch, and tree mortality have already occurred.
Prescott scale *Matsucoccus vexillorm*	Ponderosa pine	Arizona	Pockets of heavily infested trees were identified on private ownerships in Prescott and in the Clint's Wells area.
Saw flies *Diprion* spp.	Conifers	Arizona, New Mexico	Caused some minor defoliation in east Flagstaff, AZ, and Questa, NM.

Table 2--Status of other insects in Arizona and New Mexico, 1987--Continued

Insect	Host	Location	Remarks
Scarab beetles *Phyllophaga* spp.	Ponderosa pine	New Mexico	Caused scattered areas of ponderosa pine defoliation on approximately 2,000 acres of private ownerships east of Guadalupita, NM.
Western tent caterpillar *Malacosoma* spp.	Hardwoods; shrubs	Arizona	Caused widespread defoliation on private ownerships in the Payson, Prescott, and Strawberry areas.
White fir needle miner *Epinotia meritana*	White fir	Arizona	Caused light defoliation to white fir on the Coconino and Kaibab National Forests totaling 1,120 acres.

STATUS OF DISEASES

Dwarf mistletoes. The dwarf mistletoes (Arceuthobium spp.) are the most damaging agents of commercial timber throughout the Southwest. Over 2.2 of the 4.8 million total acres of commercial National Forest land are currently infested. Estimates of annual growth loss range from 100 to 150 million board feet for Arizona and New Mexico. Three principle hosts and dwarf mistletoe species are involved: Ponderosa pine, A. vaginatum subsp. cryptopodum; spruce, A. microcarpum; and Douglas-fir, A. douglasii. A. vaginatum is responsible for the greatest losses.

Presuppression surveys were conducted in 1987 on 78,857 acres of infested ponderosa pine stands on a total of 13 Ranger Districts in six National Forests. Data on the incidence and severity of mistletoe was obtained in the stands surveyed. This information, along with the growth and yield program RMYLD2, aided in the evaluation and selection of silvicultural prescriptions for the stands.

The Regionwide mistletoe survey continued in 1986 to encompass the Gila and Prescott National Forests. Information pertaining to distribution, severity, and volume losses associated with A. vaginatum is available for these Forests, as well as for the Cibola and Carson National Forests (see Recent Publications).

Stem cankers and decay. Aspen stands in Arizona and New Mexico are attacked by a number of stem cankering fungi including: Ceratocystis fimbriata, Hypoxylon mammatum, Cenangium singulare (Encoelia pruinosa), Cytospora chrysosperma, and Cryptosphareria populina. Canker fungi cause significant reductions in growth and vigor in mature aspen stands, as a result of tree mortality, top breakage, cull, and degrading. In many of the Region's aspen stands, 30 percent or more of the stems are affected. In addition, aspen timber type suffers widespread losses to stem decay caused by the false tinder fungus, Phellinus tremulae. White trunk rot incidence is especially significant in mature aspen stands, and cull volumes may range as high as 50 to 60 percent of the total standing volume. As the aspen resource is developed in this Region, and aspen stands are more routinely subjected to timber management planning and commercial entries, it will be necessary to critically evaluate the impact of these diseases and develop management strategies for their control.

Root diseases. Root and butt rot pathogens are responsible for approximately 10-percent reduction in yield Regionwide. Armillaria spp. accounts for most of the wood volume loss in conifers, especially ponderosa pine. Other root pathogens, including Fomes annosus, Phaeolus scheinitzii, and Inonotus tomentosus, are responsible for the remaining loss. Annual losses due to mortality from root rots range from 15-20 MMBF. If growth losses are included, loss estimates run as high as 45 MMBF.

Foliage diseases. A fairly sizable outbreak of Lophodermella needle cast (Lophodermella cerina) in ponderosa pine was detected by the aerial survey of the Lincoln National Forest and the Mescalero Indian Reservation in New Mexico. Approximately 4,040 acres of ponderosa pine were infested on the Lincoln National Forest, with 560 of those acres on the Cloudcroft Ranger District and 3,480 acres on the Smokey Bear Ranger District. A total of 14,960 acres of infested ponderosa pine were detected on the Mescalero Indian Reservation.

Nursery diseases. Seedbed fumigation with methyl bromide and cloropicrin continued to be evaluated at the Albuquerque Tree Nursery. Pre- and post fumigation surveys indicated that fumigation still effectively reduced the levels of Fusarium spp. in the soil, with a resultant increase in seedling survival.

Table 3--Status of diseases in Arizona and New Mexico, 1987

Disease	Host	Location	Remarks
STEM AND BRANCH DISEASES			
Comandra blister rust *Cronartium comandrae*	Mondell pine, ponderosa pine	Arizona	Comandra rust occurs in the Payson and Prescott areas in Arizona on exotic Mondell and the native ponderosa pines. Damage has been restricted to individual trees but the possibility exists for the disease to spread to nearby Christmas tree plantations.
Dwarf mistletoes *Arceuthobium* spp.	Douglas-fir, Engelmann spruce, ponderosa pine	Arizona, New Mexico	Dwarf mistletoe infestation causes a decrease in wood volume yield on commercial forest lands. Approximately 46% (2.2 million acres) of the total commercial acreage (4.8 million acres) are infested. Losses in wood production may exceed 25 million cubic feet of commercial timber in New Mexico and Arizona. As a point of reference, the total estimated annual increment of commercial wood volume of host conifers is approximately 202 million cubic feet.
False timber fungus *Phellinus tremulae*	Aspen	Arizona, New Mexico	*Phellinus tremulae* is responsible for the most common cull and defect in aspen. This white trunk rot, widespread throughout the host type, causes significant losses, especially in mature stands. Cull volumes may equal as much as 60 percent of the total volume.
Fir broom rust *Melampsorella caryophyllacearum*	True firs	Arizona, New Mexico	Fir broom rust is widely distributed in subalpine, corkbark, and white firs, and causes occasional top breakage.
Powell limb rust *Peridermium filamentosum*	Ponderosa pine	Arizona	Limb rust is found in mature and overmature ponderosa pine in scattered locations on the Fort Apache Indian Reservation in Arizona. The disease causes minor damage to infected trees and is mainly a concern when identifying seed trees in infected stands.

Table 3--Status of diseases in Arizona and New Mexico, 1987--Continued

Disease	Host	Location	Remarks
Red ring rot *Phellinus pini*	Douglas-fir, ponderosa pine, spruce,	Arizona, New Mexico	*Phellinus pini* is indigenous to mature and overmature stands of pine and mixed conifers. Scattered in distribution, losses and damage are minimal in most stands. It has also been found on immature pine and mixed conifers in suppressed conditions.
Rust-red stringy rot *Echinodontium tinctorium*	Spruce, true firs	Arizona, New Mexico	Indian paint fungus is scattered in mature and overmature stands of mixed conifers, but causes insignificant losses.
Spruce broom rust *Chrysomyxa arctostaphyli*	Spruce	Arizona, New Mexico	Spruce broom rust is scattered throughout the host type but is of little commercial significance.
Stem cankers *Ceratocystis fimbriata* *Hypoxylon mammatum* *Cenangium singulare* *Cryptosphaeria populina*	Aspen	Arizona, New Mexico	Canker fungi caused significant reductions in the yield of mature aspen stands. Damage includes tree mortality, from girdling cankers, top breakage, cull, and decay. In many stands, over 30 percent of the stems are infected with one or more of these stem canker fungi.
ROOT DISEASES			
Annosus root disease *Heterobasidion annosum*	Douglas-fir, ponderosa pine, spruce, true firs	Arizona, New Mexico	The Southwest loses an estimated 15 to 20 million board feet annually to root rot. Losses may be as high as 25 percent in some seriously infested stands. Proportionately *Armillaria* spp. accounts for 80 percent of the root disease damage in conifers and other root pathogens are responsible for the remaining 20 percent.
Armillaria root disease *Armillaria* spp.	Douglas-fir, ponderosa pine, true firs	Arizona, New Mexico	
Red-brown butt rot *Phaeolus schweinitzii*	Douglas-fir, true fir	Arizona, New Mexico	
Tomentosus root rot *Inonotus tomentosus*	Ponderosa pine, spruce	Arizona, New Mexico	
Ganoderma applanatum	Aspen	Arizona, New Mexico	Scattered throughout the host type, the fungus causes windthrow and standing cull.

Table 3--Status of diseases in Arizona and New Mexico, 1987--Continued

Disease	Host	Location	Remarks
Black stain root disease *Ceratocystis wageneri*	Pinyon pine ponderosa pine	Arizona, New Mexico	Black stain root disease is scattered throughout the Southwest. Losses are insignificant in commercial timber.
FOLIAGE DISEASES			
Elytroderma disease *Elytroderma deformans*	Pinyon pine, ponderosa pine	Arizona, New Mexico	Elytroderma disease was widely distributed but at low levels.
Fir needle disease *Lirula abies-concoluris*	White fir	New Mexico	Scattered infections of this disease were reported on the Carson National Forest this summer. Damage was insignificant.
Lophodermella needle cast *Lophodermella cerina*	Ponderosa Pine	Arizona, New Mexico	Ponderosa pine of all ages were reported as infected with this needle cast on the Carson, Lincoln, and Gila National Forests, the Mescalero Indian Reservation, NM, and the Fort Apache Indian Reservation, AZ. Incidence was limited to individual and small groups of trees, except on the Lincoln National Forest and the Mescalero Indian Reservation, NM, where approximately 4,040 and 14,960 acres were infested, respectively.
Marssonina blight *Marssonina populi*	Aspen	New Mexico	This blight has decreased to insignificant levels in 1987. Although there were still small patches of infected trees on the Santa Fe and Carson National Forests, it was not widespread enough to be a significant problem or to affect fall coloration.
OTHER			
Abiotic & unknown	White Fir	Arizona, New Mexico	Abiotic declines, possibly a result of off site planting, have been reported in residential areas, conference centers and parks.
Leaf scorch	Elm and various ornamentals	Arizona, New Mexico	Leaf scorch has been widely reported on a variety of woody landscape plants throughout the summer of 1987.

FOREST PEST MANAGEMENT ACTIVITIES IN 1987

Major activities of the Southwestern Region Forest Pest Management (FPM) Staff include detection, evaluation, and suppression of forest pests and technical assistance to forest land managers on all Federal lands in Arizona and New Mexico. In addition, FPM personnel cooperated with the States of Arizona and New Mexico in carrying out forest pest management activities on State and private lands through the Cooperative Forest Pest Action Program.

Detection surveys

Detecting and monitoring insect and disease outbreaks and infestations is a major responsibility of the FPM Staff. This is accomplished by systematic aerial surveys, ground examinations, and encouraging forest workers to report unusual and suspected insect and disease occurrences by means of field surveillance kits provided by FPM.

Aerial surveys were conducted from July through August over 9.4 million acres of coniferous forests in Arizona and New Mexico to determine the location and extent of damage caused by insects and/or diseases. Upon completion of the surveys, maps showing the location, relative intensity, and kinds of outbreaks were prepared and sent to the respective administrative units.

Ground examinations were made, when necessary, to confirm aerial detection observations, as well as in response to requests from land managers for detailed information or identification. State pest management specialists conducted ground surveys on State and private lands in Arizona and New Mexico.

A wide variety of insects and diseases were identified by the staff from surveillance reports sent by forest workers from across the Region (Tables 2 and 3). Such reports are important for the early detection of potential pest problems, and land managers and forest workers are encouraged to continue to be alert for, and prompt in reporting, any unusual insect and disease activity.

Evaluations

Another major responsibility of FPM is to conduct biological evaluations of forest insect and disease pests and provide land managers with alternatives and recommendations for management through a variety of approaches. In 1987, FPM conducted the following biological evaluations:

A. Entomology

(1) Western spruce budworm egg mass surveys, Apache-Sitgreaves National Forests, AZ, and Carson and Santa Fe National Forests, NM; (2) western spruce budworm larval population survey, Lincoln National Forest and Mescalero Apache Indian Reservation, NM (follow-up evaluating 1984 suppression project treatment effectiveness); (3) Douglas-fir beetle survey, Questa Ranger District, Carson National Forest, NM; and (4) pandora moth survey, Grand Canyon National Park, AZ.

B. Pathology

(1) Effects of soil fumigation on soilborne plant pathogens and seedlings at the Albuquerque Tree Nursery, Cibola National Forest, New Mexico; (2) hazard tree evaluation, Redondo Campground, Jemez Ranger District, Santa Fe National Forest, New Mexico; (3) ponderosa pine dieback, Odart Mountain, Ft. Apache Indian Reservation, Arizona; (4) Benji dwarf mistletoe suppression project, El Rito Ranger District, Carson National Forest, New Mexico; (5) Sandia Ski Area stand diagnosis, Sandia Ranger District, Cibola National Forest, New Mexico; (6) Archuleta-El Poso suppression project, Jicarilla Indian Reservation, New Mexico; (7) Bear Springs suppression project, Southern Peublos Agency, New Mexico; (8) Whitetail-Elk dwarf mistletoe suppression project, Mescalero Apache Indian Reservation, New Mexico; (9) Laguna-Zuni dwarf mistletoe suppression project, Laguna and Zuni Indian Pueblos, New Mexico; (10) Deer Pond dwarf mistletoe suppression project, Northern Pueblos Agency, New Mexico; (11) evaluation of prescriptions for 467 acres of dwarf mistletoe infested cuttings on the Leggett Planning Area, Reserve Ranger District, Gila National Forest: (12) Underwood dwarf mistletoe suppression project post treatment evaluation, Luna Ranger District Gila National Forest; (13) Ft. Bayard National Cemetary true mistletoe (Phorandendron juniperinum subsp. juniperinum) in Arizona cypress (Cupressus arizonica), Ft. Bayard, New Mexico; (14) Ft. Apache dwarf mistletoe suppression project evaluation, Ft. Apache Agency, Arizona.

Suppression projects

Forest insect and disease pests occasionally increase to significant levels and cause unacceptable damages to forest resources. These pests must then be managed by employing a combination of silvicultural, mechanical, biological, and/or chemical suppression strategies.

In 1987, the Carson National Forest, in conjunction with Forest Pest Management, aerially treated 13,400 acres of the mixed conifer forest cover type with the biological insecticide, Bacillus thuringiensis (B.t.). Eleven campgrounds were also treated with ground spray applications of B.t.

Also in 1987, FPM conducted or participated in the following suppression projects: Thinning, pruning, chipping, and/or removing infested trees to control dwarf mistletoe infestations on a total of 493 acres of National Forest lands as listed in Table 4:

Table 4--Dwarf mistletoe presuppression surveys and suppression projects conducted during 1987

National Forest	Ranger District	Acres	Survey	Suppression
Apache Sitgreaves	Alpine	300		X
Carson	Questa	4,000	X	
Coconino	Blue Ridge	13,200	X	
	Blue Ridge	40		X
	Flagstaff	8,500	X	
	Long Valley	24,000	X	
	Mormon Lake	8,000	X	
Gila	Luna	1,000	X	
	Luna	153		X
Kaibab	North Kaibab	6,100	X	
	Tusayan	1,557	X	
Santa Fe	Jemez	6,000	X	
Tonto	Payson	6,500	X	

The Integrated Forest Protection and Integrated Resource Management concepts

Integrated Forest Protection (IFP) is a forest pest management decision-making process derived from the concepts and principles of Integrated Pest Management (IPM). This process involves the collection and synthesis of available knowledge on pest-host relationships, including the structure and function of forest ecosystems in general, to provide an information base for effective decision-making. This information includes: (1) The ecology of pest-host systems, (2) the impacts of unregulated pest populations on resource values, (3) alternative pest management strategies and their effects on pests and resources of immediate concern, other pest organisms, and the forest ecosystem in general, and (4) the economic and social implications of alternative management strategies. This process has an overall objective of identifying effective strategies that are ecologically and socially acceptable. IFP differs from other pest management concepts by focusing on forest stands rather than pest populations and has nine discrete steps embracing three decision points. To be effective, IFP must be incorporated into overall project planning and implementation. As part of the IFP initiative, FPM specialists have participated as members of interdisciplinary project planning teams in Arizona and New Mexico.

Integrated Resource Management (IRM) is a land management philosophy which recognizes that all the natural resources are connected through an intricate series of inter-relationships. These inter-relationships cause any impact

generating activity which affects one resource to have simultaneous effects on other resources. FPM participates in the IRM process and utilizes this process as a vehicle to implement IFP in the Southwestern Region. FPM staff members are, therefore, participating in IRM workshops, training sessions, and following the IRM process in pest management activities.

RECENT PUBLICATIONS

Beatty, Jerome S., Paul F. Hessburg, and Helen M. Maffei. 1987. Incidence, severity, and growth losses associated with ponderosa pine dwarf mistletoe on the Carson National Forest. R-3 87-5. 29 p.

Cota, Jesus A. 1987. Operational use of a biological insecticide: Bacillus thuringiensis for control of the western spruce budworm in northern New Mexico. R-3 87-6. 26 p.

Maffei, Helen M., Jerome S. Beatty, and Paul F. Hessburg. 1987. Incidence, severity, and growth losses associated with ponderosa pine dwarf mistletoe on the Cibola National Forest, New Mexico. R-3 87-8. 27 p.

Maffei, Helen M., Jerome S. Beatty, and Paul F. Hessburg. 1987. Incidence, severity, and growth losses associated with ponderosa pine dwarf mistletoe on the Prescott National Forest, Arizona. R-3 87-9. 27 p.

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